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University of Maine

Maine Agricultural Experiment Station

ORONO

BULLETIN 261 JUNE, 1917

REPORT OF PROGRESS ON ANIMAL HUSBANDRY INVESTIGATIONS IN 1916

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AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE

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BULLETIN 261

REPORT OF PROGRESS ON ANIMAL HUSBANDRY INVESTIGATIONS IN 1916[1]

BY RAYMOND PEARL.

As in former cases, this report will deal with the progress which has been made in the animal husbandry investigations carried on by the Maine Agricultural Experiment Station. It is a pleasure to be able to report that these investigations have progressed in a generally satisfactory manner during 1916. In the succeeding portions of this report we shall consider one by one the different lines along which these investigations are progressing.

1. COOPERATIVE BREEDING RECORDS.

The cooperative breeding record project, in which about 200 of the leading breeders of cattle in Maine, and a few outside of the State, have contributed for purposes of study, exact records of the breeding operations in their herds, has gone forward satisfactorily. A very large amount of new material has been collected in the year. It is expected that with the completion of the Service Records for the calendar year 1916 there will be in hand approximately 2000 complete and connected Service and Birth breeding records. This constitutes a wholly unique mass of material for the study of many vitally important problems in the physiology of reproduction in cattle. As the amount of material mentioned will be amply sufficient for the

[1]Papers from the Biological Laboratory of the Maine Agricultural Experiment Station, No. 111.

This report of progress during the year 1916 of the work on animal breeding and related lines (exclusive of work with poultry) carried on in the Biological Laboratory of the Maine Agricultural Experiment Station, was in part presented as the report of the Committee on Breeding of the Maine Dairymen's Association, at the meeting held in Augusta on December 7, 1916.

study of the problem in hand, it is proposed to bring this breeding record project to a close at the end of September, 1917. No more Service Records will be asked for after January 1, 1917, and only such Birth Records as are needed to complete the Service Records already in hand.

We wish again to express our great indebtedness to the breeders who have so carefully, and conscientiously, and willingly aided in the prosecution of this phase of the animal husbandry investigations.

At this time it seems desirable to present a complete list of the breeders who have aided in this project. This is accordingly done in Table I. In addition to the name and address of each breeder the following facts are presented: (1) the number of females (cows and heifers) in each cooperator's herd; (2) the breed of the animals; (3) the number of herd bulls regularly kept; (4) whether the bulls are pure-bred or not; (5) what the breeder's regular practice is as to the mating of his animals relative to the period of heat in which they are at the time of breeding.

TABLE 1.

List of Cooperating Breeders.

Name.	Address.	No. of cows and heifers.	Breed	No. of herd bulls	Are herd bulls pure-bred?	Breeding practice.
Allen, D. E.	Blue Hill	8	Ayrshire	2	Yes	Late.
Allen, Harry C.	Buckfield	8	Jersey	0	—	At most convenient time.
Ames, Bertram C	Orono	5	Jersey	1	Yes	As early as convenient.
Ames, C. Lester.	Bridgton	5	Jersey	0	—	No fixed rule.
Andrews, Carl E.	Jefferson	6	Various	1	Yes	Late in general never early.
Austin, A. A.	Ridlonville	19	Holstein	1	Yes	Late.
Babb, Geo. H.	Sebago	6	Various	0	—	As soon as discovered.
Barker, A. W.	Easton	2	Jersey	0	—	Early.
Bean, C. S.	Wellington	9	Jersey	1	No	Late.
Bell, Harold M.	Islesboro	4	Holstein	1	Yes	Early.
Benn, Oscar A.	Houlton	12	Jersey	1	Yes	Serve twice when possible when first noticed; and about 6 hours later.
Bennett, J. B.	Dexter	11	Jersey	1	No	Late if possible.
Beyer, H. G., Jr.	Portland	100	Holstein	3	Yes	Late.
Bickford, E. F.	Dixmont	7	Holstein and Shorthorn	1	Yes	Prefer early.

List of Cooperating Breeders, Continued.

Name.	Address.	No. of cows and heifers	Breed	No. of herd bulls	Are herd bulls pure-bred?	Breeding practice.
Billings, F. H.	Brooksville	2	Jersey	0	—	Late.
Black, Elmer E.	West Baldwin	9	Jersey	1	Yes	Odd heat for female calves.
Blair, Lyman.	Greenville	20	Guernsey	1	Yes	Generally first; not always.
Boyd, D. C.	Ea. Newport	11	Holstein	1	Yes	Late.
Bradford, T. B.	Goldenridge	15	Jersey	1	Yes	No fixed rule.
Bradford, W. B.	Turner	5	Jersey	0	—	Early as possible.
Brown, H. J.	Portland	6	Guernsey	1	Yes	Early.
Buffalo Creek Farm.	Arlington Heights, Ill.	64	Holstein	2	Yes	Early.
Bumpus, Wm. E.	Mechanic Falls	40	Jersey	3	Yes	Early.
Burr, Leon T.	Winthrop	21	Holstein	1	Yes	When first noticed if possible.
Butters, H. E.	Exeter	12	Holstein	1	Yes	Late.
Cairns, A. W.	So. Paris	10	Holstein	1	Yes	Early as possible.
Call, Everett D.	Pittsfield	10	Guernsey	2	Yes	Late if served but once; prefer to serve night and morning.
Cathro, Ewen A.	Argentina, S. Ameriea	50	Shorthorn	1	Yes	Early.
Clark, C. F.	Clark's Mills	20	Holstein	1	Yes	Early.
Clark, R. C.	Lisbon	6	Jersey	0	—	Late, usually.
Clements, Chas.	Winterport	16	Jersey	1	No	No rule.
Cobb, C. F.	Lisbon Falls	12	Jersey	2	Yes	Early unless old cow: then serve twice.
Colburn, W. L.	Ashland	2	Jersey	0	—	Early.
Cole, R. F.	Winterport	10	Holstein	1	—	No fixed rule.
Cooley, Henry.	Solon	10	Jersey	1	Yes	Early if possible.
Coston, H. H.	Pittsfield	8	Guernsey	0	—	No rule.
Crocker, E. G.	St. Albans	18	Guernsey	2	Yes	No rule.
Cummings, A. D.	So. Paris	15	Holstein	1	Yes	Usually late.
Curtis, C. C.	Dexter	6	Jersey	0	—	Late.
Curtis, E. D.	Bantam, Conn.	15	Holstein and Guernsey	2	Yes	No rule.
Curtis, Norman.	Bowdoinham	8	Jersey	1	Yes	Late.
Dalbey, W. E.	Granville	12	Guernsey	1	Yes	Early.
Davis, A. C.	Harrison	5	Holstein	1	Yes	Early.
Davis, E. A.	Liberty	5	Various	2	Yes	Early.
Davis, E. L.	Harrison	7	Holstein	1	Yes	Early.
Davis, Herbert.	Eaton	5	Various	1	Yes	Bull allowed to run with cows.
Davis, J. Frank.	Hampden Highlands	14	Holstein	0	—	Late.
Davis, Tyler S.	Union	8	Jersey	1	Yes	Late.
Day, Harold S.	Lewiston	25	Ayrshire	1	Yes	Early.
Day, Jesse L.	West Kennebunk	10	Guernsey	0	—	Late.
Dean, J. L.	Waterville	17	Jersey	1	Yes	As soon convenient after noting her conditions.
Deering, A. M.	Bridgton	12	Jersey	1	Yes	When convenient.
De Land, Frank.	South Portland	20	———	1	Yes	Late.
Dingley, W. M.	Gardiner	8	Various	2	Yes	Middle of heat.
Dow, Fred N.	Portland	56	Ayrshire	3	Yes	Early.
Dow, John H.	Mapleton	4	Various	1	Yes	Early.
Dunn, F. J.	Bangor	8	Jersey	1	No	Late.
Dunn, W. H. & G. H.	Norway	23	Ayrshire	2	Yes	Early.
Dyer, Isaac.	Gorham	12	Jersey	2	Yes	Early.
Eastman, W. H.	Corinna	3	Jersey	0	—	Usually late.
Eaton, H. D.	North Cornville	17	Hereford	4	Yes	Both early and late.

List of Cooperating Breeders, Continued.

Name.	Address.	No. of cows and heifers	Breed	No. of herd bulls	Are herd bulls pure-bred?	Breeding practice.
Ellis, A. H.	Fairfield	9	Shorthorn	2	Yes	No fixed rule.
Ford, J. H.	Anson	9	Jersey	1	No	Early.
Foster, G. E.	Skowhegan	20	Guernsey	5	Yes	Usually early.
Fuller, C. F.	Skowhegan	20	Guernsey	2	Yes	No rule.
Gardiner, R. H.	Gardiner	30	Various	1	Yes	———
Gerrish, H. W.	Cornish	11	Jersey	0	—	Late.
Getchell, Mrs. Ida.	Machias	2	Holstein	0	—	Early.
Goding, L. S.	Monmouth	10	Guernsey	1	Yes	Late.
Goodrich, M. B.	Brunswick	3	Jersey	0	—	Most convenient time.
Good Will Home Association	Hinckley	30	Ayrshire	3	Yes	Early.
Graham, J. L.	Ea. Corinth	12	Jersey	1	Yes	Early.
Griffen, S. F.	Alfred	10	Guernsey	1	Yes	Reckoned by time of day.
Hatch, E. J.	Augusta	3	Various	0		Most convenient time.
Hawes, S. H.	West Brooksville	11	Jersey	0	—	Early.
Hayford, Ralph.	Belfast	9	Guernsey	1	Yes	Late.
Higgins, B. W.	Levant	14	Jersey	1	Yes	Early if possible.
Higgins, H. H.	Mapleton	5	Jersey	0	—	Early.
Hilton, A. T.	Athens	9	Jersey	1	No	As soon after noticed as convenient.
Holbrook, E. A.	Vanceboro	12	Holstein	1	Yes	No rule.
Holston & Paine.	Cornish	30	Jersey	2	Yes	Early.
Hooper, Wm. H.	Biddeford	28	Holstein	1	Yes	No rule.
Harrison, H. A., M. D.	Utica, N. Y.	100	Holstein	4	Yes	No rule.
Ireland, G. F.	Dryden	6	Guernsey	1	No	Late.
Jackson, C. E.	Bryant's Pond	8	Holstein-Jersey Cross	1	No	Early.
Jackson, G. B.	Waterville	13	Various	0	—	Late.
Johnson, E. E.	Hebron	10	Holstein	0	—	No rule.
Johnston, E. L.	Easton	4	Jersey	1	Yes	Early.
Johnson, H. O.	East Sullivan	8	Guernsey	1	Yes	Late if possible.
Jones, C. L.	Corinna	9	Holstein	1	Yes	Sometimes twice, both early and late.
Jones, R. O.	Winslow	8	Jersey	1	Yes	Usually alternate heat theory.
Jordan, C. E.	Mechanic Falls	3	Holstein	0	—	Late.
Jubilee Dairy Farm.	Pekin, Ill.	75	Brown Swiss	1	Yes	Early.
Kent's Hill Seminary.	Kent's Hill	26	Holstein	2	Yes	Late.
Kilgore, E. K.	South Waterford	6	Jersey	2	Yes	Early.
Kimball, D. M., and Son.	Winterport	9	Jersey	2	No	About 7-10 hours after onset of heat.
Kuch, Wm. F.	Portland	2	Various	0	—	Late when convenient.
Lamkin, F. M.	Farmington	6	Various	0	—	As early as possible.
Larrabee, C. C.	Wells	12	Guernsey	1	Yes	Late.
Leach, E. R.	Newport	6	Holstein	0	—	No rule.
Leavitt, E. R.	Winthrop	12	Shorthorn and Jersey	2	No	———
Libby, P. W.	St. Albans	7	Holstein	1	Yes	As early as possible.
Lilley, S. O.	Gardiner	3	Various	0	—	Late.
Lincoln, N. M.	Corinna	16	Holstein	1	Yes	Usually late.
Longley, J. R.	Detroit	11	Holstein	1	Yes	As soon as noticed.
Loud, S. O.	Berwick	5	Various	0	—	When convenient.
Luce, R. T.	Carmel	12	Jersey and Holstein	1	Yes	As early as possible.
McCrum, Lemuel	Mars Hill	7	Ayrshire	1	Yes	Early.
McGlauflin, H. F.	Presque Isle	4	Various	1	Yes	Early.

List of Cooperating Breeders, Continued.

Name.	Address.	No. of cows and heifers	Breed	No. of herd bulls	Are herd bulls pure-bred?	Breeding practice.
McIntire, L. E. and Son.	East Waterford	29	Holstein	1	Yes	Early when possible.
Maine State Sanatorium Association.	Hebron	40	Holstein	1	Yes	Varies.
Merrill, Herman.	Lovell	9	Jersey	1	No	Early.
Millett, C. R.	West Minot	40	Holstein	1	Yes	Both early and late.
Moore, S. C.	Brooks	6	Jersey	0	—	Just before P. M. milking.
Moulton, H. M., M. D.	Cumberland Center	25	Jersey	3	Yes	Usually early.
Murray, Wm.	Hampden Highlands	3	Ayrshire	0	—	Early.
Nash, H. H.	Camden	17	Jersey and Holstein	1	Yes	Early.
National Soldiers Home.	National Soldiers' Home	60	Holstein	3	Yes	Serve just before feeding in P. M.
Neale & Dix.	Sewickley, Penn.	24	Ayrshire	2	Yes	Early.
Nelson, A. C.	West Minot	20	Holstein	1	No	Early.
Ness, John A.	Auburn	40	Ayrshire	1	Yes	No fixed rule.
Oakes, A. A.	Farmington Falls	6	Guernsey	1	Yes	No rule as to heat.
Ontario Agricultural College.	Guelph, Canada	60	Various	8	Yes	As early as possible.
Osborne, W. H.	Springfield	17	Holstein	1	Yes	No rule.
Packard, E. A.	Turner	9	Ayrshire	1	Yes	"At the zenith" (of heat)
Page, E. D.	Bangor	11	Jersey	3	Yes	Early if possible.
Page, Geo. E.	East Livermore	10	Holstein	1	Yes	No rule.
Palmer, J. F.	East Sumner	7	Jersey	0	—	Late.
Palmer, W. C.	Thorndike	20	Jersey	1	Yes	Late.
Parsons, M. C.	Hampden Highlands	9	Holstein and Durham	1	No	Usually when first noticed.
Parsons, O. J.	Patten	10	Various	1	No	Early.
Pastures, The.	Belfast	100	Jersey	2	Yes	Early.
Patten, R. T.	Skowhegan	20	———	1	Yes	No rule as to heat.
Paul, A. M.	Dexter	20	Holstein	2	Yes	Early, and when hard to settle late also.
Perkins, S. W.	West Kennebunk	12	Jersey	1	Yes	Just past middle.
Philbrook, F. W.	Greene	8	Various	1	Yes	No special time; as near middle as possible.
Pierce, I. C.	Bingham	22	Jersey	1	Yes	Sometimes early in morning and late at night.
Pike, J. M.	Lubec	15	Holstein	1	Yes	Prefer latter part of heat.
Piper, S. A.	Troy	29	Holstein	2	Yes	Early, usually.
Plant, Stewart.	Gardiner	6	———	0	—	As soon as possible after coming in heat.
Plummer, H. E.	North Whitefield	8	Hereford	1	Yes	Early.
Pope, Chas. S.	Manchester	50	Jersey	3	Yes	No rule.
Porter, E. L.	West Paris	8	Various	1	Yes	Early.
Potter, F. A.	Old Town	35	Holstein	1	Yes	Early.
Powers, A. J.	Ft. Fairfield	7	Brown Swiss	1	Yes	Early.
Pulsifer, C. L.	East Poland	12	Holstein	1	Yse	No rule.
Reed, J. H.	Waterville	12	Various	1	Yes	Early.
Rieker, J. F.	North Saco	14	Jersey	1	Yes	No rule.
Ricker, L. A.	Buckfield	6	Jersey	0	—	Late.
Rines, J. H.	Portland	34	Guernsey	2	Yes	When convenient.
Ring, Walter H.	Cambridge	8	Jersey	1	Yes	Late.
Rose, S. W. and Sons.	Greene	10	Holstein	1	Yes	Usually early.
Ryder, Murray.	North Newcastle	12	Holstein	1	Yes	Late.

List of Cooperating Breeders, Concluded.

Name.	Address.	No. of cows and heifers	Breed	No. of herd bulls	Are herd bulls pure-bred?	Breeding practice.
Salley, M. H.	Dexter	12	Ayrshire	2	Yes	Early.
Sawyer, L. E.	Hebron	2	Jersey	0	—	Late.
Schrumpf, W. E.	Farmington	3	Jersey	0	—	As soon as possible after coming in heat.
Sedgley, G. W.	Maranacook	4	Jersey	0	—	Late preferred.
Small, E. A.	Cornish	9	Jersey	1	—	Early—if any signs of heat after 12 hours serve again.
Smiley, Roy C.	Augusta	4	Various	1	Yes	Early.
Smith, Owen W.	Portland	10	Jersey	2	Yes	Early.
Smith, Ralph L.	Kennebunkport	8	Various	0	—	As soon as possible.
Smith, R. V.	Steuben	11	Jersey	1	Yes	Late.
Smith, W. G.	Dixmont	4	Jersey	0	—	Late.
Somerby, E. O.	Winn	6	Jersey	0	—	Early.
Soule, H. C.	Canton	20	Jersey	1	Yes	Late.
Stanchfield, Dura.	Easton	4	Jersey	1	Yes	Most convenient time.
Stanton, C. F.	South Paris	16	Holstein	1	Yes	Late.
Stetson, F. B.	Los Banos, Cal.	100	Holstein	3	Yes	Early.
Stover, Austin.	Sullivan	3	Various	0	—	Medium to late.
Summit Lumber Company.	Davidson	30	Holstein	1	Yes	Just before feeding in P. M.
Tarbell, E. L.	Mapleton	5	Jersey	1	Yes	Alternate heat method.
Thaanum, P. A.	Winthrop	28	Jersey	1	Yes	Generally and preferably late.
Thayer, J. M.	Paris	10	Holstein	1	Yes	Early.
Thayer, W. C.	So. Paris	7	Holstein	1	—	Early.
Tibbetts, F. L.	Dexter	30	Holstein	1	Yes	Late.
Tingley, D. H., & Son.	Readfield	11	Hereford	1	Yes	No rule.
Towne, Don M.	Madison	28	Guernsey	2	Yes	No rule.
True, Nathan C.	Litchfield	9	Guernsey	2	Yes	Late.
Tucker, Benj.	Norway	21	Holstein	1	Yes	Late.
Tucker, H. M.	Canton	11	Jersey	2	Yes	No rule.
University of Maine.	Orono	71	Various	6	Yes	No rule.
Wadsworth, W. D.	Cornish	8	Jersey	1	Yes	Early.
Walker, E. A.	Vassalboro	3	Jersey	0	—	Late.
Wheeler, G. E.	Waterville	23	Jersey and Holstein	1	No	No rule.
Whitaker, E. H.	Albion	15	Jersey	1	Yes	Usually late.
Wilkins, H. M.	Livermore Falls	16	Jersey	0	—	Usually late.
Wilson, J. A.	Brunswick	11	Dutch Belted	1	Yes	Usually late.
Winslow, E. S.	North Berwick	6	Various	1	Yes	Late.
Winslow, L. V.	Larone	6	———	0	--	———
Wood, C. J.	Skowhegan	17	Jersey	1	—	Early.
Woodsum, A. G.	Oakland	6	Various	1	Yes	Middle of heat.
Woodward, S. R.	Sebec Station	8	Jersey	1	Yes	Early.

Total 3085 cows, 217 bulls of which 131 are pure bred

From the preceeding table it appears that this cooperative work has made available data on cattle breeding from 192 different herds, including 3085 cows and heifers and 217 bulls. These herds are distributed by breeds as follows:

Breed	*Herds*
Jersey	70
Holstein-Friesian	47
Guernsey	19
Ayrshire	11
Shorthorn	2
Hereford	3
Brown-Swiss	2
Dutch Belted	1
Various[2] and mixed	33
Not recorded	4
Total	192

[2]This means more than one breed in herd.

So far as may be judged from these figures it would appear that the Jersey is still the leading breed of cattle in Maine. It is equally clear, however, that the other breeds have made, and are making, large inroads on the popularity of this breed. From all the evidence at hand one would judge that during the last 50 years the proportionate number of Jersey cattle in the State has decreased, while other breeds, particularly in recent years the Holstein-Friesian, have increased.

It is interesting to note the large proportion of Maine breeders of cattle who use pure-bred sires. Out of 146 herds in which a bull is kept and for which information on this point is given, 131, or 89.7 per cent report the bulls used as pure bred. This is very gratifying and augurs well for the future of the live-stock industry in this State.

One of the most interesting features of the table is the last column, in which are given, in condensed form, the answers to the question "Do you make it a rule in breeding to have cows served early in heat or late?" Summarizing these data we find the following facts:

Time of Service	*Number.*	*Per cent.*
Early in heat	81	42.2
Middle of heat	6	3.1
Late in heat	52	27.1
Both early and late[3]	6	3.1
On basis of alternate heat theory	3	1.6
Bull runs with cows	1	0.5
In relation to feeding or milking time	3	1.6
No regular rule[4]	36	18.7
Not reporting on this point and unclassified	4	2.1
Totals	192	100.0

[3]Includes all cases where it is the rule to serve twice during the heat period.

[4]In this category are included all cases recorded as "when convenient" and the like.

The facts brought out by this list are interesting. It is evident that the great majority of this group of breeders follow, or attempt to follow so far as they can, some definite rule in regard to the time of the heat period at which the cow shall be served. There can be no doubt further that the primary object sought, in most cases at least, is the control of the sex of the offspring. Curiously enough, however, there is nothing like unanimity of opinion as to how such control is to be gained. While roughly 42 per cent of the breeders in the group think that early service is most likely to get heifer calves, about 27 per cent are just as strongly of the opinion that service late in heat is needed to bring about this end. It is curious that only 6 or 3.1 per cent of the breeders say that they breed in the middle of heat. An examination of the actual times of breeding in hours after the onset of oestrum, shows that really these same 192 breeders are having more of their cows served in what may fairly be considered the mid-oestral period than either very early or very late.

2. PHYSIOLOGY OF REPRODUCTION.

In all of its work the Maine Agricultural Experiment Station endeavors in every possible way to meet the most pressing immediate needs of the farmers of the State for practical information at the same time that it is carrying on fundamental investigations, having for their object the discovery of the underlying principles of science on which agricultural practice depends. A good index of the immediate practical needs of the farmer is found in the inquiries and requests for information which he sends in to the Station. Experience shows that a large portion of the correspondence of the Station relating in any way to breeding has to do with inquiries concerning one or another phase of the general subject of the *physiology* of breeding. There is a great dearth of information in the available agricultural literature regarding the biological or physiological processes concerned in reproduction and breeding.

As has already been pointed out in the preceding portion of this report, the Experiment Station, through its cooperative breeding record project, is in possession of a unique body of original material throwing light on many of the most puzzling of these biological questions relating to reproduction and breeding in cattle. In view of this fact, and because of the very evident interest in this subject, and desire for information about it, it has seemed wise to devote a considerable amount of time during the past year to the preparation of a comprehensive bulletin on "The Physiology of Breeding with Special Reference to Dairy Cattle." This bulletin is now nearly ready for the press. It is expected that it will be issued as an appendix to this report sometime in the year 1917. It is estimated that it will make a volume of about 150 printed pages. This will, of course, be distributed free to residents of Maine. It will not be distributed by the Station outside of the State of Maine. Instead, the same material composing this bulletin will be issued in book form by one of the large commercial publishing firms, from whom it may be obtained, on payment of the regular price of the book, by anyone not a resident of Maine.

3. THE CONTROL OF THE SEX RATIO.

One of the primary objects for which the cooperative record project was inaugurated was to collect statistics bearing on the question as to whether the proportion of males to females in cattle could be influenced or controlled by the time of service relative to the beginning of the period of heat. Some earlier statistics[5] appeared to indicate that there was a possibility of influencing the sex ratio by paying attention to this point. It was believed to be of such extreme importance as to justify the careful study of the matter on the basis of much more extended statistics. These statistics we have now collected and analyzed and shall publish as soon as possible. In the meantime it may be reported that, with the more extended statistics in hand, it appears to be conclusively established that there is no definite or permanent relation between the time in the heat period at which the cow is served and the sex of the offspring. The apparent relation between these two factors, which is believed by many breeders to exist and which our earlier statistics appeared to indicate, seems now to be purely accidental, and to have arisen only because of the comparative meagerness of the statistics on which the matter was discussed.

TABLE 2.

Showing the Sex of the Calves Following Service at Different Parts of the Heat Period.

Heat Period	Lapsed time in hrs. from appearance of heat to service.	Sex of Offspring		Per Cent of Males
		Males	Females	
Early	Under 3 hours.	200	192	51.0
Middle	Over 3 and under 8 hours	270	252	51.7
Late	Over 8 hours	187	212	46.9
Totals		657	656	50.0

[5]Cf. Pearl, R., and Parshley, H. M. Sex Studies V. —Data on Sex Determination in Cattle. Biol. Bulletin, Vol. 24, pp. 205-225, 1913.

Pearl, R. Brief Report of Progress on Animal Husbandry Investigations in 1914, Me. Agric. Expt. Sta. Misc. Publ. 503, pp. 1-11, 1914.

The summarized results of 1313 separate and distinct matings given in Table 2 will demonstrate this point. In each one of these 1313 cases the following facts were accurately known, and reported in such a way that any bias, conscious or unconscious, of the observer could not have influenced the result: (a) the time in hours from the first appearance of heat (oestrum), as noticed by the breeder, to the time the cow was successfully served; (b) the sex of the calf resulting from this service.

It is evident fromthis table that there is no significant preponderance of females when service is early in heat. There is not now known any method by which the sex ratio or proportion of the sexes in cattle may be effectively controlled by the breeder. A more detailed account of the results, together with further statistics will be published elsewhere.

4. THE ANALYSIS OF MILK RECORDS.

The intensive study of existing records of milk and butter fat production published in the Advanced Registry reports of the various breeds has been prosecuted energetically during the past year. As was pointed out in the last report, the necessary age correction factors for milk production have now been completely worked out for the three breeds,—Jersey, Holstein-Friesian, and Ayrshire. The necessity for these age corrections has been emphasized in former reports. Before it is possible to make any just comparison between the productivity of two cows it is necessary that a proper scientific correction be made for their difference in age at the time when the milk records were made. The working out of proper corrections has involved a great deal of extremely laborious mathematical work. This work, however, is now completed and we are able to use these correction factors in a constructive way.

As a first contribution in this direction we have considered in the Jersey breed the influence of certain advanced registry bulls on the productive qualities of the breed. A complete report on this phase of the work, which will include data corresponding to those for Tables 3, 4, and 5 for every Register of Merit bull of the Jersey breed having two or more daughters whose dams have records, will be issued as an appendix to this report as soon as it can be prepared for the press.

Tables 3, 4, and 5 show in abbreviated form the effect of 23 of the best known Jersey sires on the average milk, fat test, and net butter fat production of their daughters as compared with the dams of these daughters. It appears from these tables that about one-half of the bulls in this group got daughters which on the average were poorer producers than the dams of those daughters. In some cases the deleterious effect of the bull on the productive qualities of his offspring was extremely marked. On the other hand, certain of the bulls in this group, notably Hood Farm Torono, exercised an extraordinarily beneficial effect upon the productive qualities of the breed.

TABLE 3.

Showing the Influence of Certain Jersey Bulls on the Breed, as Indicated By the Average Yearly Production of Milk of Their Daughters as Compared With That of the Dams of These Daughters.

+denotes that daughter's average was *higher* than dams' average
—denotes that daughter's average was *lower* than dams' average

NAME OF BULL	LBS. OF MILK BY WHICH DAUGHTERS' AVERAGE IS DIFFERENT FROM DAMS'	
Group A. Bulls which significantly lowered the productivity of their daughters.	+	—
Hector Marigold 59121		3001.0
Hood Farm's, Tormentor 76311		1555.6
Irene's King Pogis 73182		1540.9
Lady Letty's Victor 65020		1396.2
Mabel's Raleigh 77913		965.7
Hood Farm Torono 21st 83413		800.5
Noble of Oaklands 95700		453.3
Hood Farm Torono 20th 82854		252.8
Mabel's Poet 65789		139.0
Group B. Bulls wihch neither lowered nor increased productivity significantly		
Tonona Pogis 78657	96.9	
Interested Prince 58224	70.1	
Gedney Farm Oxford Lad 71338	128.7	
Group C. Bulls which significantly increased the productivity of their daughters.		
Flying Fox's Victor 64768	285.0	
Lookout Torono 78593	385.7	
Hood Farm Pogis 9th 55552	464.3	
Mabel's Oxford Lad 66518	590.0	
Gamboge's Knight 95968	627.4	
Raleigh's Fairy Boy 83767	715.8	
Eminent's Raleigh 69011	1313.0	
Royal Majesty 79313	2138.6	
Hood Farm Pogis 34th 63309	2427.5	
Fontaine's King 65641	2880.0	
Hood Farm Torono 60326	2946.1	

TABLE 4.

Showing the Influence of Certain Jersey Bulls on the Breed, as Indicated By the Average Fat Percentage of the Milk of Their Daughters as Compared With That of the Dams of These Daughters.

+denotes that daughter's average was *higher* than dams' average
—denotes that daughter's average was *lower* than dams' average

NAME OF BULL	PERCENTAGE OF FAT BY WHICH DAUGHTERS' AVERAGE IS DIFFERENT FROM DAMS'	
Group A. Bulls which significantly lowered the fat percentage of their daughters	+	—
Eminent's Raleigh 69011		1.203
Raleigh's Fairy Boy 83767		0.637
Fontaine's King 65641		0.588
Lookout Torono 78593		0.288
Royal Majesty 79313		0.264
Group B. Bulls which neither lowered nor increased fat percentage significantly		
Hood Farm Torono 60326		0.144
Hood Farm Pogis 34th 63300		0.094
Hood Farm Torono 20th 82854		0.073
Gedney Farm Oxford Lad 71238		0.071
Interested Prince 58224		0.055
Mabel's Poet 65780		0.053
Mabel's Raleigh 77913	0.030	
Lady Letty's Victor 65020	0.118	
Gamboge's Knight 95698	0.140	
Group C. Bulls which significantly increased the fat percentage of their daughters		
Flying Fox's Victor 64768	0.221	
Hood Farm's Tormentor 76311	0.271	
Hood Farm Torono 21st 83413	0.272	
Hood Farm Pogis 9th 55552	0.282	
Mabel's Oxford Lad 66518	0.314	
Nobel of Oaklands 95700	0.386	
Tonona Pogis 78657	0.446	
Irene's King Pogis 73182	0.658	
Hector Marigold 59121	0.715	

TABLE 5.

Showing the Influence of Certain Jersey Bulls on the Breed, as Indicated By the Average Yearly Production of Milk of Their Daughters as Compared With That of the Dams of These Daughters.

+denotes that daughter's average was *higher* than dams' average
—denotes that daughter's average was *lower* than dams' average

NAME OF BULL	LBS. OF BUTTER FAT BY WHICH DAUGHTERS' AVERAGE IS DIFFERENT FROM DAMS'	
Group A. Bulls which significantly lowered the productivity of their daughters.	+	—
Hector Marigold 59121		106.55
Hood Farm S. Tormentor 76311		61.59
Mabel's Raleigh 77913		46.00
Eminent's Raleigh 69011		41.74
Irene's King Pogis 73182		35.12
Raleigh's Fairy Boy 83767		31.72
Lady Letty's Victor 6592)		21.72
Hood Farm Torono 20th 82854		21.27
Hood Farm Torono 21st 83413		20.85
Mabel's Poet 65780		11.88
Group B. Bulls which neither lowered nor increased productivity significantly		
Interested Prince 58224	0.41	
Gedney Farm Oxford Lad 71238	1.57	
Lookout Torono 78593	1.70	
Noble of Oaklands 95700	4.24	
Group C. Bulls which significantly increased the productivity of their daughters.		
Flying Fox's Victor 64768	33.94	
Tonona Pogis 78657	47.00	
Gamboge's Knight 95698	47.49	
Hood Farm Pogis 9th 55552	51.83	
Mabel's Oxford Lad 66518	60.76	
Royal Majesty 79313	81.34	
Fontaine's King 65641	101.37	
Hood Farm Pogis 34th 63390	140.48	
Hood Farm Torono 60326	148.56	

5. NEW COOPERATIVE PROJECT.

The Maine Agricultural Experiment Station wishes to call attention to a plan for a new cooperative project which it will take up with the breeders of Maine provided they are interested in the matter. The most important thing which a breeder of dairy cattle desires to know is whether his animals are transmitting productive qualities to their progeny. In particular this information is desired in regard to the herd bull, which constitutes one-half of the herd. If by chance he is exercising a deleterious effect on the productive qualities of the herd he may in a few years time do a great deal of harm. It would appear to be beyond doubt or question for practical purposes, that if a bull's daughters are on the average poorer milkers, or poorer in the quality of their milk, than the dams from which they came, then the bull which produced them is exercising a harmful effect upon the herd. On the other hand, if a bull's daughters are on the average measurably better than the dams from which they came in productive qualities, then that bull is exercising a beneficial effect on the herd. What the breeder wants to know at the earliest possible moment is which of these two categories his herd bull falls into. The writer has worked out a plan whereby it is believed that it will be possible to furnish this sort of information to the breeders of the State more quickly and in a much more definite and precise form than they have ever been able to acquire it hitherto.

The plan of cooperation involves the following points: Any farmer who will comply with certain conditions may at any time have made for him by the Experiment Station an Official Daughter-Dam test.

The conditions are:

(a). That he shall have in his herd at the same time both the dam and her daughter to be tested. Or failing the actual possession of the animals at the time he must be able to furnish satisfactory records of the milk production of the missing animal, either daughter or dam, together with the other necessary information for making the test.

(b). The breeder or farmer undertaking such a cooperative test under the directions furnished by the Expermient Station must agree to keep a careful and accurate record of the milk of the animals on test over a period of time mutually agreed upon (7 day; 14 day; 30 day; 90 day; or one year).

(c). Anyone desiring to take up such a test should write to the Director of the Maine Agricultural Experiment Station asking for an application blank form, which he should fill out and return at once. This form is given on page 138.

(d). Samples of the milk of the animals on test shall be regularly taken, according to directions which will be furnished, and sent to the Maine Agricultural Experiment Station. There an analysis of the milk will be made and the necessary calculations for making proper age corrections for the animals concerned will be carried out. An official report will then be rendered to the breeder as to whether in the particular case involved the sire produced a daughter which was a better or a poorer producer than her dam when both are compared on an equal age basis. The report will be in the form given on page 139.

(e). The only expense to the breeder involved in having such a test carried through is the expressage on the samples of milk to Orono, and postage on reports. This cooperative daughter-dam testing project will be open on precisely equal terms to owners of grade cattle as well as owners of pure-breds.

APPLICATION FOR DAUGHTER-DAM TEST.

(One blank should be made out for each daughter-dam pair to be tested).

I,————(*name of applicant*)————, desire hereby to make application for an Official Daughter-Dam Test. I agree to follow faithfully to the best of my ability any and all instructions, rules, and regulations regarding this Test which may be laid down by the Maine Agricultural Experiment Station through its officers. I agree that at any time during the Test my premises, including barns and herd, shall be open freely to inspection, without prior notice, by any properly accredited representative of the Experiment Station, and I further agree to give such representative any information which he may desire regarding the carrying out of the Test.

Signed.....
Address.....

The Following Questions Must be Answered Before the Test Can be Started.

1. Is the daughter to be tested now in herd?.....
2. Is the dam to be tested now in herd?.....
3. If answer to either 1 or 2 is "No," what record of past performance of the animal can you furnish?.....
4. Do you desire a 7 day, 14 day, 30 day, or 1 year test?..... (*A short test is recommended*).
5. Are the animals to be tested grades or pure-breds?.....
6. Has either an Advanced Registry Record?.....
7. To what breed do the animals to be tested belong?.....
8. Give the name, breed, and registry number (if pure-bred) of the sire of the daughter to be tested?.....
9. When was this bull born? Year....., Month....., Day.....
10. When did the dam freshen?.....
11. When did the daughter freshen?.....
12. When was the dam born? Year....., Month....., Day.....
13. When was the daughter born? Year....., Month....., Day.....
14. When do you want to start the test?
15. Do you agree to weigh accurately, and record the milk at each milking, and to take proper samples according to directions and ship them promptly to Orono for analysis?.....

This blank should be completely filled out and returned at once to Raymond Pearl, Orono, Maine, in the addressed envelope provided for that purpose.

Official Daughter-Dam Test.

Maine Agricultural Experiment Station
Orono, Maine
Chas. D. Woods, Director.

This is to certify that an Official Daughter-Dam Test has been made by the Maine Agricultural Experiment Station on the animals and with the results hereinafter set forth.

The cow.....(*Name of daughter*)..... sired by the.... ....(*Breed of bull*).... bull.....(*Name of bull*)..... out of the .....(*Breed of dam*)..... cow.....(*Name of dam*)..... made, in comparison with her dam, the following record in.....days, beginning.....

The daughter freshened.....

The dam freshened.....

Animal	Age at Test.	Actual milk yield.	Milk yield corrected for age and stage of lactation.	Actual average fat %.	Average fat % corrected for age and stage of lactation.	Actual net fat yield.	Net fat yield corrected for age and stage of lactation.
Daughter							
Dam							
Net gain or loss of daughter over dam.							

So far as this test indicates the bull..... the net fat yield of this daughter in comparison with the net fat yield of her dam.

Signed.....
Director.

.....
Biologist.

6. BREEDING EXPERIMENTS.

The experiments in cattle breeding which are being carried out with the University of Maine herd have proceeded satisfactorily during the year. These experiments are along the line of experimental hybridization. This is the only method now known by which one may hope to make an *adequate* analysis of the laws of heredity.

In view of these considerations we are endeavoring as rapidly as possible to build up an experimental herd of first generation crosses between low milking and high milking breeds, on the one hand, and between low testing and high testing breeds, on the other hand. It is gratifying to be able to report that this experimental cross-bred herd is now nearly completed. To February 9, 1917 a total of 42 animals have been produced of which some 14 will probably be permanently retained in the experimental herd. The remainder have been, or will be, sold as fast as they pass the age of 200 days when certain records are taken on them. To complete the herd, so that analytical experiments may go forward, there are now required only six heifers. Owing to the fact that a control of sex in the individual case is impossible, it is likely to take at least one or two years more to complete the experimental herd. After these six heifers have been obtained probably no more *first generation* crosses will be bred.

The breeds used in the formation of the experimental herd are the Jersey, the Holstein-Friesian, and the Aberdeen Angus. The Ayrshire and Guernsey breeds were used in some preliminary work, but will not be continued. It is interesting to note that one first generation hybrid animal is now in milk, having borne a heifer belonging to the second hybrid generation on April 10, 1916. Another heifer belonging to the second cross-bred generation was born August 17, 1915. It is the second cross-bred generation which yields the important results in Mendelian experiments.

A complete list of the calves born in the experimental herd between January 1, 1916, and February 9, 1917, is given in Table 6. In conjunction with the list given in the last report[6] this gives all the cross-bred calves obtained in the experiments.

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[6]Pearl, R. Report of Progress on Animal Husbandry Investigations in 1915. Me. Agric. Expt. Stat. Misc. Publ. 519, pp. 1-27, 1915.

TABLE 6.

Calves Which have been Produced in the Hybridization Experiments between January 1, 1916 and February 9, 1917

Calf No.	Sex.	Dropped.	Sire's Name and Registry Number.	Breed of Sire.	Dam's Name and Registry Number	Breed of Dam.
18	♂	January 1, 1916.	Kayan (167617).	Aberdeen Angus.	Rutb 8th (4457).	Jersey (M. S. J. H. B.).
19	♀	January 1, 1916.	Kayan (167617).	Aberdeen Angus.	Ruth 8tb (4457).	Jersey (M. S. J. H. B.).
20	♂	January 10, 1916.	Taurus Creamelle Hengerveld (98482)	Holstein-Friesian.	Maple Grove Netta (29307).	Ayrshire.
21	♂	January 14, 1916.	Kayan (167617).	Aberdeen Angus.	Dot Alaska (29353).	Ayrshire.
22	♀	February 22, 1916.	Kayan (167617).	Aberdeen Angus.	College Creusa (25661).	Guernsey.
23	♂	Mareb 9, 1916.	Taurus Creamelle Hengerveld (98482)	Holstein-Friesian.	Columbia Brown Bessie ( )	Jersey.
24	♂	March 20, 1916.	Kayan (167617)(0).	Aberdeen Angus.	College Creusa 2d (34227).	Guernsey.
25	♀	April 10, 1916.	F_1 Cross-bred (0).	Jersey x Holstein.	F_1 Cross-bred (1).	Jersey x Holstein.
26	♀	May 5, 1916.	Kayan (167617).	Aberdeen Angus.	Creusa of Orono 3rd (34228).	Guernsey.
27	♀	May 25, 1916.	Lakeland's Poet (102603).	Jersey.	Orono Madge (192781).	Aberdeen Angus.
28	♂	June 17, 1916.	Kayan (167617).	Aberdeen Angus.	Pauline Posch (81048).	Holstein-Friesian.
29	♀	July 19, 1916.	Kayan (167617).	Aberdeen Angus.	Creusa's Lady (53234).	Guernsey.
30	♂	August 29, 1916.	Taurus Creamelle Hengerveld (98482)	Holstein-Friesian.	Orono Ellen (192783).	Aberdeen Angus.
31	♂	September 11, 1916.	Lakeland's Poet (102603).	Jersey.	Eventime 4th (155526).	Aberdeen Angus.
32	♂	September 25, 1916.	Kayan (167617).	Aberdeen Angus.	Canada's Creusa (44386).	Guernsey.
33	♀	October 9, 1916.	Lady Primrose's Governor of tbe Fountain (18328).	Guernsey.	Hearthbloom (147141).	Aberdeen Angus.
34	♀	October 17, 1916.	F_1 Cross-bred (0).	Jersey x Holstein.	Rosalie (4887).	Jersey (M. S. J. H. B.).
35	♂	November 10, 1916.	Taurus Creamelle Hengerveld (98482)	Holstein-Friesian.	Flying Fox's Flora (274051).	Jersey.
36	♂	December 15, 1916.	Kayan (167617).	Aberdeen Angus.	Orono Netta (38832).	Ayrshire.
37	♀	January 5, 1917.	Kayan (167617).	Aberdeen Angus.	Dot Alaska (29353).	Ayrshire.
38	♂	January 13, 1917.	Kayan (167617).	Aberdeen Angus.	College Creusa (25661).	Guernsey.
39	♂	January 28, 1917.	Kayan (167617).	Aberdeen Angus.	Rue Victoria (273096).	Jersey.
40	♂	February 9, 1917.	Kayan (167617).	Aberdeen Angus.	College Creusa 2nd (34227).	Guernsey.
41	♀	February 9, 1917.	Kayan (167617).	Aberdeen Angus.	College Gem 2nd (53235).	Guernsey.

7. REPORT OF THE SECOND JERSEY SIRES' FUTURITY TEST OF THE AROOSTOOK JERSEY BREEDERS' ASSOCIATION.

The first of these sires' futurity tests was held at Aroostook Farm in the late autumn of 1915, and the results have been reported.[7]

The first test attracted a great deal of favorable attention both in the State and out. It was hoped that the second test, which was held at Aroostook Farm, Presque Isle, Maine, October 9-15 inclusive, 1916, would have a larger number of entries than the first, but this hope was not realized, for a variety of reasons which need not be gone into here. The second test was carried out under the same rules as the first (loc. cit. pp. 41-46) and with the supervision of a representative of the Experiment Station, Mr. C. Harry White.

ANIMALS IN THE 1916 TEST.

Heifer No. 1.—Irene. Owned by Mr. E. L. Johnston, Easton, Maine.
Sire.—Daisy's Pogis of Meadow Farm (98184).
Dam.—A grade cow.
Dropped.—July 29, 1914. Freshened—September 8, 1916.
Weight.—850 pounds.

Heifer No. 2.—Brownie. Owned by Mr. Peter Johnson, Easton, Maine.
Sire.—Daisy's Pogis of Meadow Farm (98184).
Dam.—A grade cow.
Dropped.—March 12, 1914. Freshened.—September 18, 1916.
Weight.—705 pounds.

Heifer No. 3.—Julia. Owned by Mr. George McNaughton, Easton, Maine.
Sire.—Daisy's Pogis of Meadow Farm (98184).
Dam.—A grade cow.
Dropped.—July 3, 1914. Freshened.—May 1, 1916.
Weight.—630 pounds.

Heifer No. 4.—Poet's Fanny Harper (312849). Owned by L. H. Denton, Caribou, Me.
Sire.—Brackett Farm Poet (77588).
Dam.—Fannie Harper 2nd (263451).
Dropped.—April 28, 1914. Freshened.—March 18, 1916.
Weight.—710 pounds.

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[7]Pearl, R. Report of the First Jersey Sires' Futurity Test of the Aroostook Jersey Breeders' Association. Me. Agric. Expt. Sta. Bulletin No. 247, pp. 37-52, 1916.

Fat Production.

Table 7 gives the detailed production of butter fat of each of the animals in the test at each milking, after correction for age and stage of lactation. These corrections were made on the basis of the Dairy Efficiency Table published in a former report (p. 5).[8]

TABLE 7.

Net Corrected Butter-Fat Production of Heifers in 1916 Test.

Date	Irene (No. 1)			Brownie (No. 2)			Julia (No. 3).			Fanny Harper (No. 4).		
	Morning	Noon	Night	Morning	Noon	Night	Morning	Noon	Night	Morning	Noon	Night
Oct. 9	.80	.75	.74	.36	.30	.29	.42	.41	.42	.50	.52	.56
10	.25	.92	.77	.33	.31	.36	.37	.34	.34	.52	.42	.52
11	.68	.69	.63	.32	.19	.10	.43	.37	.40	.50	.50	.47
12	.62	.59	.61	.10	.08	.12	.42	.39	.39	.50	.45	.46
13	.60	.65	.61	.14	.28	.21	.44	.40	.46	.51	.44	.55
14	.64	.57	.62	.19	.20	.21	.46	.43	.43	.51	.50	.60
15	.62	.67	.68	.20	.22	.20	.45	.42	.37	.51	.60	.50
Totals	13.71 lb.			4.71 lb.			[a]8.56 lb.			10.64 lb.		

[a] Pearl, R. Report of Progress on Animal Husbandry Investigations in 1915. Me. Agric. Expt. Sta. Misc. Publ. 519, pp. 1-27, 1915.

From these figures it appears that the animals in the test stood in the following order:

Irene (No. 1) was the winner, with 13.71 lbs. fat in 7 days. Her sire, Daisy's Pogis of Meadow Farm (98184), was for the second time the winner of the American Jersey Cattle Club Cup.

Poet's Fanny Harper (No. 4) was second, with 10.64 lbs. fat in 7 days.

The records of the other two heifers were so poor as not to warrant the award of prize money.